Handheld, Non-Contact Wound Measurement Device

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Background

Repeatable and accurate wound measurement forms an important part in the assessment and treatment of chronic wounds and pressure ulcers.

Current wound measurement methods span a continuum:

- from the ruler method which is easy to perform but lacks accuracy
- to devices using stereophotogrammetry which are accurate and repeatable but are expensive

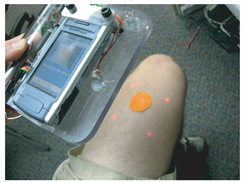
Design Goal

To design, fabricate and test a handheld, noncontact, affordable wound measurement device.

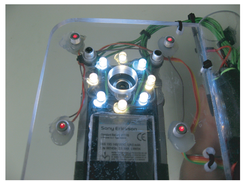
Design Features

- Simple digital camera (current device uses a cell phone)
- Laser pointers and computer vision techniques permit distance measurement and skew correction
- Wound margin detected using canny edge detection

Device Photo

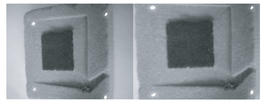


Top side with touch screen



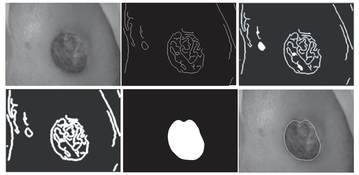
Bottom side with lasers & LEDs for illumination

Skew Correction



left to right: diagram, skewed, corrected

Iterative Edge Detection



User Interface

Touch screen interface permits the user to:

- accept the area (if the wound boundary detection is correct)
- modify the wound boundary by dragging the outline using a stylus on the touch screen
- reject the wound boundary and re-trace the wound manually using the stylus

Detected wound edge.

Modification of boundary using the pull technique.

Modification of boundary using 'blob' technique.

Manual Tracing Repeatability

Two wounds

- One wound selected because of its poorly defined margin

Ten repeated measurement trials

- Results blinded to subject

Tracing Repeatability Results

	Wound 1		Wound 2	
subject	Pixel mean	C.V	Pixel mean	C.V
1	9603	2.13%	5340	8.68%
2	10380	4.53%	8440	9.99%
3	10458	6.84%	7596	7.71%

Distance & Skew Accuracy

- 3.8 x 3.8 cm 'wound' (14.44 sq com)
- Image taken at different heights and degrees of skew

Distance & Skew Test Results

skew angle	Distance= 19.5 cm	Distance = 17.7 cm
0	13.64	13.71
10	13.17	13.85
15	13.22	13.81
20	13.86	14.31
30	14.08	14.62
35	13.31	14.51
mean	13.55	14.14
avg error	6.2%	2.1%
Coef Variation	2.8%	2.8%

Conclusion

- A simple wound measurement device has been developed and tested
  - Novel distance and skew determination permits non-contact measurement
  - Low cost components (<$100) will lead to affordable device
- Accuracy at different distances & skew:
  - ≈ 6%
  - exceed those of photography, tracing & Kundin gage
- Repeatability
  - Coefficient of variation
    - <7% for well-defined ulcer
    - < 10% for poorly-defined ulcer
- Clinical testing underway
- Ready for Technology transfer

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